LET'S DO CHEMISTRY

Molecules in Motion Facilitator Guide

ACTIVITY LEARNING GOALS

Learners will develop positive attitudes toward learning about chemistry:

- Learners will increase their feelings of **interest** in chemistry through observation of phenomena.
- Learners will increase their understanding of the **relevance** of chemistry by exploring connections to everyday life.
- Learners will increase their sense of **self-efficacy** related to chemistry through hands-on interaction and manipulation of the materials.

Learners will explore chemistry concepts, tools, and practices:

- An important part of the process of chemistry is to experiment and try different things over and over.
- Chemists study how different materials behave and change, and how materials interact with each other.

FACILITATION STRATEGIES

Encourage **interest**, **relevance**, and **self-efficacy** through hands-on interaction with objects and tools. Ask participants to share their observations about how the objects are changing in the vacuum chamber. Do all the objects undergo the same changes when the air is removed from the chamber? Discuss the properties of the objects. Are they soft? Squishy? Hard? What are they made from? Can participants predict that some objects will change inside the vacuum chamber, while others might not?

MATERIALS

- Magnetic whiteboard
- Red molecule dot magnets
- Mini bell jar with syringe
- Whiteboard marker
- 2 squishy toys
- 2 gel-type squishy balls
- 2 ping pong balls
- Space science connection info sheet
- Bowl to hold objects

Optional: Incorporate additional objects to test inside the vacuum chamber. Candy Peeps or marshmallows and shaving cream behave in surprising (and messy) ways. Add a buzzer or other sound toy fixed to the side or lid of the chamber. Does it sound the same inside the vacuum?

SAFETY

Always follow and model prudent practices when doing chemistry activities.
Think about:

- What **hazards** exist and what associated risks may arise from these hazards?
- How to **minimize** risks through protocols we have designed into the activities and training materials.
- How **safe practices and protocols** should best be communicated with facilitators, participants, and others.

The vacuum pump is challenging to disconnect and should be done with caution. Make sure you secure the chamber to keep it from popping open.

Your institution may have special rules or protocols for chemistry related activities, so check with your facilities staff, safety committee, and/or others. Learn more about safe practices in the *Let's Do Chemistry: Safety Guide* included in the physical kit and with the online digital kit resources.

FACILITATION NOTES

This activity makes a great connection to the **2018 National Chemistry Week theme: Chemistry is Out of This World!** In space there is little to no air pressure, but there is a lot of air pressure here on the surface of Earth. The vacuum pump removes air from the chamber, creating a model of what it's like in space. Encourage visitors to make connections to space and explore how these familiar objects might change if they rose through the atmosphere towards space. You can even name the object you place into the jar the "space object," and call the comparison object your "Earth object." If participants are interested in this space science connection, encourage them to read and discuss the info sheet to learn more about how animals adapted to extreme environments on Earth are helping NASA understand what alien life might look like elsewhere in our solar system and beyond.

The whiteboard and magnets can be helpful visual tools during discussions about material properties and air pressure. On the whiteboard, use the red dot magnets to represent air molecules and draw in arrows to indicate where the air is "pushing." Ask participants to think about why it gets harder and harder to pull the syringe out as more and more air is removed from the chamber. Help them think about the air molecules all around us. Invite participants to feel the air by moving their hands back and forth.

When you set up the chamber, it is helpful to hold the lid on until enough air is removed that the seal is established. Try holding the chamber with the lid on top. Visitors can help connect the vacuum system, but you should check to ensure that no air can enter.

Participants can feel how the vacuum pump works by placing one fingertip on either end of the tubing. When they pull the plunger back, the syringe sucks air in through one end and pushes it out the other end. There are two one-way valves in the tubing connected to the syringe, so the air being removed by the syringe does not re-enter the chamber when the plunger is pushed back in.

An activity training video is available at vimeo.com/channels/nisenet.

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